SPECIFICATION

Docket No. 20470.046-AP

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, Bradford G. Corbett, Jr., a citizen of the United States, residing in Fort Worth, Texas, have invented new and useful improvements in an

ABRASION AND OIL RESISTANT PIPE GASKET WITH NYLON COATING

of which the following is a specification:

BACKGROUND OF THE INVENTION

1. Cross -Reference to Related Application:

The present application claims priority from the following U.S. Provisional Application Serial No. 60/449,258, filed February 21, 2003, entitled "Abrasion and Oil Resistant Pipe Gasket and with Nylon Coating," and invented by Bradford G. Corbett, Jr.

2. Field of the Invention:

The present invention relates generally to sealing systems for fluid conveying pipes and, more specifically, to an improved belling process for installing a gasket in a socket end of a thermoplastic pipe.

3. Description of the Prior Art:

A variety of piping systems are known for the conveyance of fluids which employ elastomeric type sealing rings or gaskets. The pipes used in such systems may be formed of PVC, polyolefins such as PE and PP, ductile iron, concrete, clay, fiberglass, steel, cast iron, fiberglass/cement reinforced pipes and such metals as aluminum and copper. Pipes formed from thermoplastic materials including polyethylene and PVC are used in a variety of industries but are particularly useful in municipal water and sewage systems. In forming a joint between thermoplastic sections of pipe, the spigot or male pipe end is inserted within the female or socket pipe end. An annular, elastomeric ring or gasket is typically seated within a groove formed in the socket end of the thermoplastic pipe. As the spigot is inserted within the socket, the gasket provides the major seal capacity for the joint. It is critical, during the installation process, that the gasket not be able to twist or flip since a displaced or dislocated gasket will adversely affect the ultimate sealing capacity of the joint.

Despite advances in the art of sealing rings for fluid conveying piping, certain problems continue to occur both in the manufacture of the joint and integral gasket and in certain field

applications. In the manufacturing plant, frictional resistance between the gasket and mandrel or pipe could hamper the forming operation. In some field operations, particularly involving larger diameter pipe, the insertion force needed to install the male spigot end within the mating socket end could, on some occasions, cause the gasket to be distorted or displaced.

One attempted solution, both in the manufacturing plant and in the field, was to utilize a liquid lubricant to reduce frictional forces. The lubricant could be applied during formation of the pipe joint and at the point of assembly of the pipe joint in the field, as by brushing, spraying or dipping the gasket in a suitable liquid or viscous lubricant compound. This approach was messy and inconsistent and often proved to be unsatisfactory. The lubricating effect was not permanent or even semi-permanent.

Accordingly, it is an object of the present invention to provide an improved pipe belling process of the type described which is more efficient and which produces more consistent results utilizing a fixed external coating rather than using a liquid lubricant.

It is also an object of the present invention to provide a pipe gasket with a novel external permanent coating which facilities the manufacturing operation and which also provides a lower insertion force for the male, spigot end when entering the female, spigot end to facilitate assembly of the pipe joint in the field.

Another object of the invention is to provide a permanent, external coating for a sealing gasket of the type described, which coating provides improved abrasion resistance, greater oil resistance than nitrile rubber at a fraction of the cost as well as the option of color coding gaskets by type or application.

SUMMARY OF THE INVENTION

A method is shown for installing a gasket in a socket end of a thermoplastic pipe which is used to form a pipe coupling. A mandrel is provided with an inner end and an outer end and having a generally cylindrical outer working surface. A gasket is installed at a first circumferential position on the outer working surface. The gasket has at least selected surfaces coated with the coating of the invention. A retention member is provided at a second circumferential location on the mandrel nearer the inner end of the mandrel with the retention member abutting the gasket in a normally extended position. A socket end of a thermoplastic pipe is then heated and forced over the working surface of the mandrel and over the gasket, whereby the heated socket end of the thermoplastic pipe flows over the gasket to form a retention groove for retaining the gasket and again contacts the working surface of the mandrel. The heated socket end of the thermoplastic pipe is then cooled and retracted from the mandrel leaving the gasket within the retention groove of the pipe end.

The preferred gasket coatings of the invention are thermoplastic coatings. The particularly preferred gasket coatings of the invention are nylon coatings. A particularly preferred commercially available nylon coating is sold under the brand name RILSAN®, available from Atofina Corporation of Paris, France. RILSAN® is the Atofina brandname for the polyamides 6, 11 and 12 family of nylon polymers.

The coatings can enable a less expensive material to be used in products with characteristics equivalent to more expensive materials. The coatings can be colored as well.

In the preferred embodiment, the gasket is an elastomeric, ring shaped member having a circumferential contact area and an exterior surface, coating of the invention being applied to at least selected portions of the circumferential contact area.

Additional objects, features and advantages will be apparent in the written description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partial, perspective view, partly broken away showing a pipe joint manufactured according to the method of the invention, the male spigot pipe end being inserted within a female socket end to form the pipe joint;

Figure 2 is a side, cross-sectional view of a gasket used in the method of the invention, the gasket having the external coating of the invention applied to a contact surface thereof;

Figures 3-6 are simplified, schematic illustrations of the prior art RIEBER™ process for installing a compression, seal gasket within a groove formed within the female socket end of a thermoplastic pipe;

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a sealing gasket of the invention, designated generally as 43 which is installed within a groove 45 provided within a socket end 47 of a thermoplastic pipe. The gasket 43 has the improved non-stick anti-friction coating so that insertion of the male, spigot pipe section 49 within the female, socket section 47 can be achieved with a minimum insertion force while maintaining the desired compression seal for the joint so made up.

Turning to Figure 2, there is shown a pipe sealing gasket of the invention designated generally as 73. The gasket 73, includes a nose region 75 which is joined to a lower compression region 77 by a leading curved surface region 79 which defines an angle α_1 with respect to the horizontal axis 81 drawn parallel to a central axis 61 of the pipe. The lower compression region 77 is joined to a secondary seal surface 83 by a trailing curved surface region 85 and an intermediate circumferential groove region 87. The trailing curved surface region 85 defines a second angle β_1 with respect to the horizontal axis 81 drawn parallel to the central axis 61 of the pipe.

The secondary seal surface 83 is a planar circumferential region which terminates in an inside corner 89 of the gasket 73. The inside corner is connected to an outer arcuate region 91 of the gasket 73 by a uniformly sloping exterior gasket surface 93. The outer arcuate region 91 is connected to the nose region 75 of the gasket by a concave curved region 95. The gasket 93 may also be provided with a reinforcing element such as the metal ring 97.

The gasket 73 is thus an elastomeric, ring shaped member having a circumferential contact area, e.g., the leading curved surface region 79, the lower compression region 77 and the secondary seal surface 83. The gasket also has an exterior surface which includes the regions 93 and 95 which generally contact the interior of the thermoplastic pipe during the forming operation. In the method of the invention, selected surfaces of the gasket are coated with the external coating of the invention. Generally, at least the leading curved surface region 79 is coated with special external coating. Preferably, the regions 79, 77 and 83 all have the coating applied thereto.

The preferred gasket coatings of the invention are thermoplastic coatings. The thermoplastic powder coatings were the first type of coatings to be developed. They are based on high molecular weight resins. Thermoplastic coating powders were developed in the early 1950's (although some research establishments had used the technique in the 1940's). The first successful application involved the placement of powdered low density polyethylene onto a preheated metal substrate using a fluidized bed, (process patented in Germany in 1954). At about this time, the first nylon coatings were introduced, (i.e., RILSAN, nylon 11). In 1962, SAMES a French company, developed a method of applying coating powders by electrostatic spray.

Today, several different processes are typically used for thermoplastic coating powders: fluidised bed, hot & flock spraying, electrostatic spray (including frictional charge guns), interior pipe coating by turbine spray gun, mini-pieces coating systems, external tube coating, wire coating etc.

Thermoplastic powder, when raised to above a particular temperature melts, flows to form continuous films. Curing is not required.

The polyamides, or commonly named nylons are characterised by their number of carbon atoms in their molecular backbone (e.g. Polyamide 6 has six carbon atoms, Polyamide 11 has 11 carbon atoms). Generally speaking, the higher the number of carbon atoms involved in the polyamide the lower its melting point and moisture uptake.

Nylon-based thermoplastic coating powders show excellent resistance to abrasion, impact, chemical such alkalis, solvents, hydrocarbons, salt atmosphere and good electrical resistance and low coefficient of friction. The coatings provide excellent flexibility and when applied as thin films, lend themselves to metal post forming. Thick coatings of the type typically used in the mechanical and printing industries are easily machined to the correct tolerance. The exterior durability provides excellent corrosion protection, adhesion and mechanical properties.

The particularly preferred gasket coatings of the invention are nylon coatings. A particularly preferred commercially available nylon coating is sold under the brand name RILSAN® , available

from Atofina Corporation of Paris, France. RILSAN® is the Atofina brandname for the Polyamide 6, 11 and 12 family of nylon polymers.

RILSAN® 6 is a polyamide (-6-6) obtained from crude oil or castor oil.

RILSAN® A (polyamide 12) is obtained from the crude oil by polycondensation of laurylactame, available in granule form.

RILSAN® B (polyamide 11), obtained from castor oil, is a polymer 100% from vegetable origin, available in granule or powder grades.

RILSAN ®Fine Powders (polyamide 11) are also obtained from castor oil.

PROPERTIES:

RILSAN® Fine Powders are preferred for the present application and have multiple outstanding properties for high-performance coatings:

- excellent abrasion resistance
- exceptional resistance to corrosion and impact
- outstanding flexibility
- remarkable chemical inertia (impervious to alkalis, hydrocarbons, organic acids, diluted mineral acids, salts, esters, etc.)
- ease of processing with a wide range of techniques
- high thermal stability
- good durability
- good insulation properties, high resistance to humid environments

COATING TECHNIQUES:

There are two main application techniques:

Dip-coating in a fluidized bed (for parts having sufficient heat capacity) the part to be protected is pre-treated, then heated in an oven and dipped in a bed of RILSAN® powder. The powder melts and forms a film by coalescence, in other words, by the fusion of the particles in contact with each other.

Electrostatic powder spraying: the electrically charged powder is applied with an electrostatic spray gun onto a cold substrate surface which has been pre-treated. Once the desired thickness is reached, the powder is fused by heating in an oven.

The coatings used in the method of the invention can also have a color additive, such as a suitable pigment, dispersed therein which impart a distinctive color to the coated region of the gasket. Color markings of this type can be used for product identification purposes, e.g., for use as a water pipe joint, a sewer pipe joint, etc.

The advantages of the method of the invention can best be understood with reference to a simplified discussion of the prior art Rieber process. Turning first to Figures 3-6, the prior art process is illustrated. Figure 3 shows a section of a conventional elastomeric sealing gasket 11 having a steel reinforcing ring 13 in place on the generally cylindrical outer working surface 15 of the mandrel 17 used in the belling process. The elastomeric gasket 11 can be formed of, for example, natural or synthetic rubber or blends thereof including SBR and is a ring shaped, circumferential member having an inner compression surface 19 and an exposed nose portion 21 which, as shown in Figure 3, abuts a forming collar 23. The forming collar 23 has a first generally cylindrical extent 25 which is joined to a second cylindrical extent 27 by a step region 29, whereby the second extent 27 is of greater external diameter than the first cylindrical extent 25, shown in Figure 3.

In the first step of the prior art process, the steel reinforced elastomeric ring 11 is thus placed onto the working surface of the mandrel 17 and pushed to a position against the back-up or forming collar 23. In this position, the gasket is firmly anchored to the mandrel surface with the rubber between the mandrel and the steel-ring of the gasket being compressed by approximately 20%.

In the second step of the prior art process, the socket end 33 of the thermoplastic pipe 31 is heated and pushed over the steel mandrel 17, gasket 11 and back-up collar 23. The socket end 33 is expanded due to the thermoplastic nature of the pipe. A number of thermoplastic materials, such as polyethylene, polypropylene and polyvinylchloride (PVC) are known in the prior art having the required expansion characteristics, depending upon the end application of the pipe joint. The socket end 33 flows over the first cylindrical extent 25 of the back-up collar 23 and abuts the step region 29 in the second step of the process.

In the next step of the prior art process (Figure 5) the mandrel and pipe move away from the back-up collar 23 and the pipe socket end 33 retracts around the mandrel and gasket 11 due to the elastic forces of the thermoplastic material. Typically, vacuum was also applied through ports 35, 37 which connected the mandrel working surface with a vacuum source (not shown).

In the final step of the prior art process, the pipe socket end 33 is cooled by means of a water spray bar 39 and spray nozzles 41. As the cooling takes place, the pipe socket end 33 shrinks around the gasket 11, thus compressing the rubber body of the gasket between the steel reinforcing ring 13 and the socket-groove to establish a firm seal.

The corrosion resistant, anti-friction coating which is applied to the selected gasket surfaces facilitates the above described manufacturing processes as well as subsequent make up of the pipe joint in the field. The coating reduces scrap rate in the manufacturing plant since gaskets can be more easily and accurately installed on the forming mandrel with reduced frictional forces. It is not necessary to modify the existing manufacturing dies used in the belling process.

The sprayed on coating reduces the mess associated with liquid lubricants which were often applied to the inside, outside or both surfaces of the gasket. Certain of the water based lubricants used in the past required relubricating during the process which was messy and inefficient. Another advantage is that the installer is not required to select the proper lubricant since the coating is already in place prior to the manufacturing operation. The coating improves the shelf life of the gasket. Oxidation resistance is improved so that SBR type materials are offered added protection when

exposed to direct sunlight. The coating of the invention provides a gasket which is more oil resistant than nitrile rubber but at a fraction of the cost. In field applications, insertion forces are reduced without altering the efficiency of the compression seal. Colored coatings can be used to mark the product type, thereby making the particular gasket type easy to recognize. The coating assists in preventing infiltration of contaminants in the case of water pipes while assisting in preventing exfiltration in the case of sewage pipes.

While the invention has been shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit thereof.